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Environmental management
of industrial wastes on
the former Lax property

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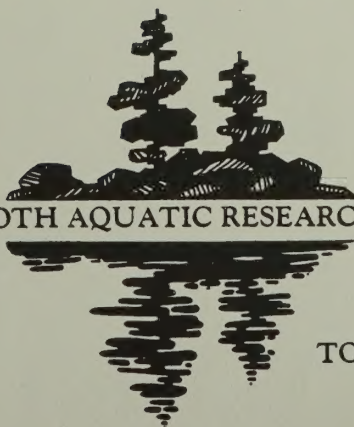
ENVIRONMENTAL MANAGEMENT OF
INDUSTRIAL WASTES ON THE
FORMER LAX PROPERTY

Prepared for
The City Architect's Department
The City of Hamilton

by
Booth Aquatic Research Group Inc.

David A. Ross
Gillian M. Booth

June 1986



BOOTH AQUATIC RESEARCH GROUP INCORPORATED

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Executive Summary

The report summarizes data from several sources which delineate the problem of pockets of industrial waste which have been deposited on the former Lax Property (referred to as the Property in this report). Recommendations are then made for the management of the Property to provide an environment safe for future public use.

Industrial waste material, primarily iron oxides of steel mill flue dust, have been found deposited both on the surface and scattered throughout the site. It is recommended that the surface piles of waste should be removed by a licenced waste disposal facility. This will eliminate any chance of erosion of the material into the Harbour or the atmosphere and will alleviate public concern. Proposals for this clean-up are appended.

Groundwater and nearshore water quality were analysed. Results show that very low levels of the metals associated with the industrial wastes are leaching into the Harbour. This evidence supports the conclusion that at present there is no cause for concern regarding contamination of the Harbour by the Property. It was recommended that groundwater monitoring be continued so that if any problems arose in future, they would be detected early and mitigative measures could be instituted at that time. The recommendations include capping the site with clay fill to reduce percolation from surface precipitation and/or installing a tile drainage system in conjunction with the proposed development.

An underwater visual survey of the perimeter of the site is recommended prior to development to determine whether there are additional deposits of industrial waste (including seepages of oil) below the water line. These could be dealt with during the dredging of the Property.

The recommended program will reduce the potential for contaminated water leaching into the Harbour, will eliminate the chance of wind erosion of the surface waste, will ensure that users of the site are not exposed to contaminated soil and will provide a conservative, environmentally and socially acceptable approach to dealing with the problem.

In summary, the recommendations include:

- (1) Remove surface industrial waste from the Property;
- (2) Award a contract for industrial waste disposal to either Philip Enterprises or Tricil Ltd. for a total cost not to exceed \$215,300 or \$164,00 respectively, based on the discussion in Appendix 1.
- (3) Institute a water quality monitoring and inspection program;
- (4) If development proceeds, then design drainage systems to minimize percolation of surface water through the site.

Introduction and Background

The City of Hamilton acquired the former Lax Property (the Property) in November, 1984. The Property was built starting in 1968 with clean fill primarily from the Clairemont Access Road. Filling with non-toxic industrial waste was permitted when a bulldozer was available to cover up waste material. It appears, however, that these conditions were not strictly adhered to. Surface soil sampling by the Ministry of the Environment (MOE) Phytotoxicology Section indicated that isolated areas contained industrial waste which had been used as fill in the construction of the Property and been left uncovered on the surface (Table 1). They recommended that some of this waste be removed from the Property, based on potential phytotoxicity, toxicity to grazing animals and human health considerations (Palmer 1985).

The City immediately arranged for further investigation into the extent of waste disposal in the Property. A series of 16 boreholes were drilled by McGlone & Associates and visual descriptions of the contents were prepared (McGlone 1985). Four of the soil sampling boreholes were prepared as piezometers to monitor the possible contamination of groundwater in the Property. The Regional Laboratories of the Municipality of Hamilton-Wentworth carried out analysis for trace metals on the cores and measured concentrations of metal contaminants in the groundwater (Forde 1985). Their report suggested that the industrial wastes on the site are in a highly oxidized state and do not pose a health hazard unless transported by wind. It was concluded that rainwater and snowmelt passing through the Property will not materially alter the concentrations of elements already present in the harbour.

The MOE Hamilton Region also monitored groundwater during the summer of 1985 using the same four piezometers as Forde (Mayes 1985). Analysis yielded similar results to those found by Forde (1985) (Table 3). The results of the chemical analyses by these three studies are summarized in Tables 1 (Palmer), 2 (Forde) and 3 (Mayes). In general, surface samples from identified waste dumpsites showed higher metal contamination than the pockets of material which are distributed through the Property. Much of the industrial waste on the surface is steel flue dust, which is classified by the Ministry of the Environment as a "hazardous waste". Also of concern was an oily substance which is seeping into Borehole 11 (Figure 2). This material was analyzed and found not to contain high levels of PCBs but must be disposed of appropriately.

Booth Aquatic Research Group Inc. (BAR) was retained by the City of Hamilton to develop a management plan for the removal and/or containment of these pockets of industrial waste products in the Property. Consultations with the Hamilton Region MOE office,

Regional Laboratories and consulting engineers were incorporated into the development of this plan.

All data from previously mentioned sources were reviewed and utilized to determine the impact of the contaminated fill on the environment and to facilitate the development of a management plan. Further consultations with Hamilton Region MOE raised the concern of the possible effect the contaminated fill was having on the nearshore sediment and water quality in Hamilton Harbour. A sampling program was designed to address this concern.

Evaluation: Methods

Site Inspection:

A site inspection was carried out on May 22, 1986 with John Mayes (MOE Region) and Paul Kehoe (Pollution Abatement Officer, MOE). Areas which were obviously industrial waste were identified and staked.

Water and Sediment Sampling:

Nine stations were selected around the perimeter of the Property at which to sample sediments and nearshore water. Station selection was based on proximity to sites of industrial waste disposal, observed drainage patterns and to allow for adequate representation of variability around the site (Figure 3). On December 18, 1985, water samples were collected at each station from the nearshore area (0-0.5 m depth). Surface samples were collected from each of 4 control sites in the Harbour to establish background conditions in the Harbour at the time of sampling. Water samples were analysed for parameters identified in previous studies as being present in excessive concentrations in the landfill. All samples were preserved with nitric acid and submitted to the Regional Laboratories of Hamilton-Wentworth for analysis of the concentrations of cadmium (Cd), copper (Cu), nickel (Ni), lead (Pb), zinc (Zn), manganese (Mn) and chromium (Cr). Field pH was measured on all water samples using a Cole-Parmer Digisense meter within 6 hours of the collection.

Two to four sediment samples were collected from each station at 0, 5, 10 and 20 m offshore along a transect set perpendicular to the shore. A Ponar dredge was used to collect the top 10 cm of sediment in these locations. Samples which appeared to consist of industrial waste were submitted for analysis. The remaining samples from each transect were stored in refrigerators at the Regional Laboratories. Data recorded at the time of sampling included station depth, distance from shore, sample composition, colour, cohesiveness and texture.

Sediment samples were analysed for Cd, Cu, Ni, Pb, Zn, Mn, Cr and loss on ignition (LOI) at the Regional Laboratories and for PCBs and oil and grease at Zenon Environmental Ltd.

Results are tabulated in Tables 4 and 5.

Evaluation: Results

Nearshore Sediment:

Samples from the nearshore perimeter of the Property which appeared to consist of industrial waste were analysed. Results indicated that the sediment quality found at Stations 4-9 (Figure 3) was better in all cases than the mean for Hamilton Harbour sediments found by the MOE in 1980 (MOE 1985). Trace metals, organic content (LOI) and PCBs were present only in small quantities at these stations (Table 5).

Stations 1-3 (Figure 3), all at the southeast end of the bay separating the Property from the CN tracks, exhibit concentrations of all parameters measured, except Mn, at greater levels than the 1980 Hamilton Harbour mean (Table 5) (MOE 1985).

Stations 1A and 3A had the greatest concentrations of Cd at 16 mg/kg and 10 mg/kg respectively (Table 5), greater than the 5.7 mg/kg found by the MOE in 1980 for mean results in Hamilton Harbour (MOE 1985). Sediment Cu concentration of 340 mg/kg at Station 2B next to the storm sewer outlet was about 2.5 times the 1980 mean for Hamilton Harbour. Lead concentrations were as high as 945 mg/kg at Station 1A and Ni as high as 400 mg/kg at Station 2B (Table 1). Total PCB concentrations ranged from 0.22 to 0.82 mg/kg at Stations 1-3, compared to a median of 0.200 mg/kg for harbour sediments found by the MOE in 1980 (MOE 1985). Oil and grease concentration ranged from 6,500 to 17,000 mg/kg at Stations 1-3 (Table 1).

Nearshore Water Quality:

Concentrations of trace metals in the nearshore water (Table 6) did not differ substantially from concentrations measured at control Stations 10-13 (Figure 1) or with MOE results for harbour means (MOE 1985), indicating that leaching of contaminants from the industrial waste was not detectable in ambient water quality.

The exceptions were Stations 1, 8 and 9. Station 1 had a measured concentration of Zn of 0.35 mg/L, almost 10 times the control concentrations (Table 6). Stations 1 and 8 had a measured total Mn concentration well above the control sites. Station 9 nearshore water quality showed a Zn concentration of 0.11 mg/L, greater than the control sites and measurements of harbour mean Zn of 0.046 mg/L (MOE 1985).

Site Inspection:

Figure 4 indicates approximate locations of the areas which were staked on May 22, 1986. Each is a localized surface site where industrial waste was dumped during filling of the Property. Table 7 contains descriptions of the material at each site based on identification by the Pollution Abatement Officer. The majority of the industrial waste material appears to be flue dust, identified as probably originating from Burlington Steel and dumped between 1972 and 1977 (John Vogt, pers. comm.). Other sites were determined to have smaller quantities, probably one or two truck loads, of other industrial waste, such as foundry sand, aluminum oxide and one pile of discarded battery casings.

Discussion

The studies referenced in the Introduction and subsequent site inspection found areas on the surface of the Property that are contaminated with industrial waste products and are clearly visible and lacking vegetative cover. Vertical bore hole sampling by Forde (1985) revealed additional small pockets of industrially contaminated fill to be distributed vertically and horizontally through the central area of the Property. Characterization of the contaminated fill by Forde (1985) (Table 2) and Palmer (1985) (Table 1) indicated high concentrations of Zn, Pb and Cd in some samples. Elevated levels of Cu and Cr were also noted. Oil was reported in Borehole 11.

Analysis of steel flue dust by Kramer and Murdoch (1985) indicated that the majority of the trace metals are associated with strongly bound insoluble silicates and ferrites, although Mn seemed to be quite soluble as a hydroxochloride. Dissolution of fine-grained metallic alloys and oxides by weakly acid solutions seems to mobilize some significant amounts of Cu, Cd, Pb and Zn. Measurements of pH of groundwater in the Property by Mayes (1985) and Forde (1985) revealed a range of pH 7-8. Under these conditions the majority of metal elements would remain fairly insoluble and should not threaten groundwater or harbour water quality.

However, slightly elevated concentrations of some metals were measured in the groundwater by Mayes (1985) and Forde (1985), indicating that some fraction of the total trace metals may be soluble and entering groundwaters (Table 3). Trace amounts of PCBs were also found by Mayes in some groundwaters. Some small pockets of contaminated fill discovered by Forde (1985) are below water table levels described by Trow (1984) and McGlone (1985) and are, therefore, in contact with the groundwater. Rainwater percolation may be leaching additional small quantities of contaminants from the surface pockets of industrial waste into the groundwater.

Investigations by BAR indicate that industrial waste is not currently polluting the harbour waters by groundwater or surface runoff. Nearshore water and sediment quality did not differ substantially from control stations (Tables 5 and 6) except at Stations 1-3. Nearshore sediments were somewhat more sandy than offshore sediments and contained lower concentrations of contaminants (BAR 1986).

However, nearshore sediment at Stations 1-3 was contaminated with trace metals and PCBs at concentrations which exceed Hamilton Harbour means (MOE 1985) and exceeded other samples taken from areas of proposed dredging offshore of the Property (BAR 1986). The close proximity of a storm sewer/combined sewage overflow is a potential cause of this contamination. Construction of the Property restricted the discharge of the storm sewer to the back end of a narrow bay (Figure 1) which receives little flushing. Some of this sediment contamination may also result from erosion of the nearby contaminated area at Sites 1 to 4 (Figure 4) or from exposed waste deposited in the sediments themselves.

The high concentrations of total metals found in sediments at Stations 1-3 were not significantly affecting local water quality. However, concentrations of Zn, Cu and Cr found in nearshore water did exceed the MOE guidelines for protection of aquatic life (MOE 1984). These guidelines provide a good, long-term objective for the harbour, but a more realistic comparison is with present harbour values to ensure that the Property does not adversely affect harbour waters or sediment. Zn concentrations in water sampled at Station 1A exceeded the control stations by 10 times (Table 1). At a hardness of about 200 mg CaCO₃/L in Hamilton Harbour and pH of 7, the 0.35 mg/L of total Zn measured at Station 1 would not be acutely lethal to rainbow trout (Bradley and Sprague 1985) although sublethal effects cannot be ruled out. Stormwater runoff can load substantial amounts of Zn to a water body, but in the case of Hamilton Harbour less than 1% of total Zn inputs in 1977 were the result of stormwater (MOE 1985). Poor water quality at this site may, however, be related to the contaminated sediments.

Mn was also found at an elevated concentration in water samples from Stations 1A and 8 (Figure 3). Palmer (1985) identified his site 12 (Figure 1) as having very high concentration of Mn present in surface soil samples collected. Steel flue dust is thought to contain fairly soluble Mn (Kramer and Murdoch 1985) and surface runoff may be introducing Mn to the harbour in this area. No MOE guidelines are available regarding acceptable levels of Mn for drinking water or the protection of aquatic life.

Contaminated water and sediments found at Stations 1, 2 and 3 could eventually lead to increased body burdens of persistent compounds in harbour fishes. Fish can accumulate contaminants

from their water and their food. Bottom dwelling invertebrates such as oligochaete worms have been found to concentrate substantial amounts of persistent chlorinated organics such as PCBs (Oliver 1984). Bioaccumulation can eventually produce concentrations in fish tissue that are dangerous to top level consumers. At present most fish species sampled in Hamilton Harbour by the MOE can be eaten in unlimited quantities, with some restrictions imposed on larger size classes of carp, white perch and brown bullhead (MOE 1985).

Special consideration will have to be given to the sediments in this location. The removal of these sediments will be incorporated into the dredgeate disposal plan for the waterfront development.

Pollution of Hamilton Harbour from anthropogenic sources has been occurring since the late 1800s. Hamilton Bay receives effluents from numerous industrial operations and from treated wastewater and untreated storm sewer overflow from both Hamilton and Burlington. The excessive pollution is primarily a function of high Zn and Fe levels, however, and other metal levels are similar to those reported in other harbours in the Great Lakes (Nriagu *et al.* 1983). The volume of Hamilton Bay is approximately $3 \times 10^8 \text{ m}^3$ (MOE 1978) and it drains $4.5 \times 10^8 \text{ m}^3$ per year or about 1.8% of its volume per day. The Table below is adapted from Nriagu *et al.* 1983, to illustrate the major sources of pollution into the Harbour. The groundwater (based on Mayes 1986) flushing from the former Lax Property has been included here to give perspective to the negligible levels of contaminants which might be contributed by this source.

Sources of metals into Hamilton Harbour.
(Adapted from Nriagu, except former Lax Property data
adapted from Mayes, MOE Region, pers. comm. 1986)

Source	Annual Flux ($\times 10^3$ kg/yr)					
	Cu	Pb	Zn	Cr	Fe	Mn
Municipal	6.6	4.1	34	14	120	13
Industrial	48	7.9	394	33	14,440	204
Streams (incl. Cootes Paradise)	3.5	5.9	11	4.1	450	38
Atmospheric	.13	.3	1.2	-	4.4	-
Former Lax Property	.001	.008	.092	.007	.039	.138
Total	58	18	440	51	14,970	255

Conclusions

At present the groundwater contribution of contaminants to Hamilton Harbour from the Property is negligible. The nearshore water quality survey of December, 1985, confirmed that leaching of contaminants is not currently detectable. There is, however, legitimate concern that there may be undetected leachate from buried industrial waste leaching very slowly toward the perimeter of the Property. Although this is unlikely as no problem has been detected in sampling to date, it is nevertheless an important consideration when dealing with an unmonitored landfilling operation such as the former Lax Property.

We therefore recommend that a monitoring program be instigated in consultation with the Hamilton Regional Office of the Ministry of the Environment. The City of Hamilton would then be able to detect and deal with any future leaching problems early, to minimize environmental damage.

Erosion of the surface deposits of industrial waste is of some concern. This material is technically classified as "hazardous waste" and should be removed to an appropriate disposal site. The oily material in Borehole 11 is also of concern. Even though it is non-toxic, it should be stabilized and removed to prevent future problems of seepage.

In summary, the pockets of industrial waste found on the Property are not adversely affecting Hamilton Harbour. They are, however, a source of toxic metals and should not be left open to erosion by wind and rain. Removal of the surface contamination is recommended. A monitoring program should be put in place to guard against future leaching problems and diversion of drainage from the site should be considered if development proceeds.

The following recommendations are suggested in order to minimize the potential risk of future harbour contamination resulting from surface runoff and rainwater percolation leaching surface contaminants into the groundwater. The small pockets of contaminated fill located deeper in the Property are not adversely affecting groundwaters at present, but the following plan will address future concerns.

Recommendations

- (1) The majority of the surface industrial waste should be removed from the Property. Removal of the surface material will effectively eliminate the mobilization of surface contaminants by wind erosion, surface runoff and rainwater percolation. Although these areas of contaminated soils do not appear to be currently adversely affecting the groundwaters or Hamilton Harbour, they are not able to

support plant growth and are a concern to the public. Removal will satisfy the public's concern as well as ensuring a safe environment for future use of the site. Areas that require excavation have been delineated and staked (Figure 4, Table 6).

- (2) Philip Enterprises and Tricil Ltd., the only two local companies licenced to dispose of Burlington Steel flue dust, were asked by Booth Aquatic Research to prepare proposals for dealing with the material identified in Table 7 as requiring excavation and removal. The terms of their proposals and the proposals themselves are attached in Appendix 1.
- (3) A monitoring plan should be initiated to ensure that no unexpected leachate contaminates the groundwater in the Property or seeps into the Harbour. A recommended study design is attached in Appendix 2. The Ministry of the Environment should be approached for approval of the design and possible assistance in implementation of the monitoring program.
- (4) If development proceeds then attention should be given to minimizing the flow of groundwater through the Property. This can be accomplished by diverting surface drainage into storm sewers and capping the existing surface with relatively impermeable clay prior to landscaping with topsoil. The clay requires compaction to prevent channels developing which allow water to percolate through. A compaction of 1×10^{-7} cm/sec permeability of 1 m of clay is set, for example, as a requirement for waste landfill sites in the United States.

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Table 1. Concentrations(dry weight) of 16 elements,conductivity, and pH in soil samples(0-15 cm depth) collected from 13 stations at the City of Hamilton proposed park site on November 29,1984. Due to the high concentration of many of elements,the values given are approximate. Station 5 is a control. See Figure 1. for station locations. Results in ppm. unless otherwise noted.
From Palmer,1985.

Station	Al %	An	As	Bo	Cd	Ca	Cr	Cu	Fe %	Pb	Mn	Mo	Ni	Se	Vn	Zn	Cond. mahos/cm	pH
1	25.0	13.0	3.9	690	28	0.9	220	7200	1.3	1800	2000	14	130	4	44	14000	4.0	7.1
2	1.0	63.0	96	12000	600	3.5	2300	2200	22	23000	45000	500	1000	3	1000	280000	1.2	8.8
3	0.4	41.0	92	8200	450	3.6	2800	2400	31	19000	57000	250	290	2	200	180000	0.3	8.5
4	0.9	3.0	9.7	3600	16	4	120	110	3.3	2000	3100	10	42	0.4	31	7700	0.3	7.7
5	1.0	11.0	5.5	12	1	4.7	16	43	2	48	690	1	16	0.2	23	140	0.3	7.7
6	1.9	0.5	8.7	34	1.3	3.6	27	13	3.4	19	690	1	28	0.4	29	100	0.1	7.9
7	0.5	0.5	1.7	21	1.0	1.3	170	43	1.1	50	1400	18	250	1.9	11	280	0.1	7.9
8	1.0	1.4	6.8	17	1.4	2.2	20	55	2.2	370	830	1	16	0.6	26	250	0.2	7.8
9	2.1	1.3	1.4	46	1.5	3	29	12	3.8	29	740	2	29	0.5	33	91	0.1	8
10	0.1	0.2	1.4	10	0.6	0.6	600	19	2.4	21	190	57	2500	0.5	9	90	0.1	8.4
11	1.6	12	15	3300	140	2.8	310	470	7.7	7100	10000	100	230	1.6	200	69000	0.2	8.1
12	1.0	69	87	15000	760	3.9	1800	1900	19	20000	36000	500	1000	4.3	1000	320000	0.4	8.2
13	0.5	24	90	3800	250	6.4	2300	1400	31	16000	47000	92	200	0.6	100	82000	0.3	8.4
MOE Proposed Clean-Up	-	-	25	-	4	-	1000	300	-	500	-	5	200	5	-	800	-	-

Table 2. Analysis of borehole samples from the Lax Property, by Hamilton-Wentworth Regional Laboratories, August, 1985. Results in mg/kg dry weight unless noted. From Forde, 1985.

Stat.-depth(m)	Al(%)	Cd	Cr	Cu	Fe(%)	Mn	Ni	Pb	Zn
1-1	0.43	155.0	1012.5	970.0	11.30	24250.0	117.0	20375.0	41000.0
1-2	0.82	2.5	115.0	95.0	1.80	1262.5	26.5	712.0	1350.0
1-6	1.09	3.0	75.0	32.0	1.70	887.5	26.0	95.0	800.0
2-4	0.86	3.0	99.0	41.0	1.50	675.0	27.0	82.0	400.0
2-6	0.95	4.0	1475.5	190.0	8.00	1425.0	91.5	133.5	750.0
3-2	0.80	2.5	97.5	29.5	1.30	587.5	23.5	65.0	125.0
3-8	0.25	2.0	275.0	32.0	1.60	2775.0	29.0	92.5	150.0
3-10	0.66	2.5	143.0	57.0	3.00	3862.5	36.0	69.0	650.0
3-11	0.75	3.5	850.0	62.0	7.10	25000.0	43.5	337.5	350.0
4-1	0.99	3.0	90.0	42.5	3.20	1437.5	22.0	103.0	950.0
4-4	0.77	2.5	58.0	29.0	1.90	750.0	19.5	5.5	150.0
5-2	0.47	5.0	74.0	34.5	1.52	1037.5	13.0	325.0	2225.0
5-6	0.76	3.5	79.0	64.0	2.70	825.0	23.0	121.5	620.0
6-1	0.70	7.0	71.0	42.0	2.50	950.0	22.0	400.0	2000.0
6-2	0.76	10.0	86.0	41.0	2.70	1012.5	23.5	600.0	2975.0
7-1	0.88	6.0	129.5	43.0	2.70	837.5	28.5	450.0	2150.0
7-7	1.04	3.0	75.5	26.0	2.90	860.0	26.0	40.0	200.0
8-1	0.46	1.5	74.5	40.0	1.40	887.5	12.5	93.0	525.0
8-5	0.97	1.0	56.0	16.0	3.20	600.0	30.0	68.0	375.0
8-7	0.33	1.5	119.5	11.5	0.90	525.0	11.0	28.5	125.0
9-1	0.69	2.0	96.5	28.0	1.54	1062.5	20.0	156.0	475.0
9-2	1.22	3.0	475.0	110.0	1.95	10000.0	437.5	850.0	825.0
9-4	0.63	1.0	62.0	70.5	7.70	2920.0	34.0	262.5	225.0
10-1	0.35	1.0	56.5	29.5	1.24	860.0	12.0	97.5	350.0
10-5	1.24	2.5	237.5	120.5	1.80	7500.0	25.5	700.0	620.0
11-1	0.68	2.0	66.0	30.0	1.76	775.0	21.0	95.0	500.0
11-2	0.42	2.5	69.0	23.5	1.34	1025.0	16.5	300.0	675.0
11-3	0.41	1.5	122.5	125.0	7.60	1287.5	48.0	98.0	275.0
11-4	0.23	4.5	43.5	153.0	19.70	600.0	21.0	187.5	450.0
12-8	0.40	1.5	41.5	18.0	1.19	387.5	18.0	68.0	212.5
13-1	0.39	2.5	41.5	33.0	1.49	800.0	12.0	162.5	537.5
13-4	0.57	9.0	70.0	99.5	1.73	1537.5	16.5	787.5	3637.5
13-5	0.46	3.5	128.5	86.0	4.30	2337.5	37.5	387.5	400.0
13-7	0.50	1.5	65.0	32.0	1.84	622.5	19.5	71.0	162.5
14-1	0.46	7.0	133.5	45.0	0.99	737.5	16.5	600.0	2525.0
14-2	0.49	5.5	120.5	36.0	1.78	987.5	19.5	625.0	1700.0
15-1	1.10	4.5	225.0	42.0	1.00	160.0	17.0	287.5	700.0
16-1	0.51	7.5	111.5	56.0	1.85	1625.0	18.0	787.5	2650.0
16-2	0.56	4.0	151.0	54.5	1.77	1075.0	28.0	312.5	600.0
MOE Proposed Clean-Use Criteria	-	4	1000	300	-	-	200	500	800

Table 3. Analysis of groundwater from the Lax Property by the MOE(Mayes,1985) and Hamilton-Wentworth Regional Laboratories(Forde,1985). See Figure 2 for station locations. Results in mg/l.

Sampler	Station	Fe	Mn	Al	Cu	Cd	Cr	Cu	Ni	Pb	Zn	PCB
Mayes July,1985	2	1.700	2.400	1.500	-	<0.002	0.035	0.058	0.012	0.093	0.560	-
	3	1.600	0.600	0.860	-	<0.002	0.035	0.063	0.014	0.034	0.370	0.00002
	4	2.300	8.600	1.800	-	<0.002	0.050	0.160	0.014	0.052	0.300	0.00002
	11	1.700	2.700	0.670	-	0.010	0.033	0.047	0.014	0.150	3.700	0.0008
	13	4.200	2.300	2.200	-	0.013	0.040	0.440	0.034	0.890	5.800	
Mayes Aug,1985	2	-	9.900	1.400	<0.002	<0.002	0.073	0.074	0.024	<0.030	0.250	
	3	1.650	13.000	0.860	0.114	<0.002	0.073	0.074	0.026	<0.030	0.190	-
	4	0.100	15.000	2.100	-	0.014	0.090	0.110	0.048	<0.030	6.200	
	13	<0.060	1.900	0.340	<0.001	0.006	0.020	0.044	0.015	0.040	1.800	-
Forde Aug,1985	2	-	2.53	-	-	<0.01	0.17	0	<0.1	0	0.03	-
	3	-	0.30	-	-	<0.01	0.16	0	0	0	<0.01	-
	4	-	0.94	-	-	<0.01	0.75	<0.01	0	<0.01	0.2	-
	13	-	1.29	-	-	<0.01	0.26	0.02	0	0	0.42	-

< : indicates concentration near detection limit; actual value may be less than this

Table 4 Physical description of sediment samples collected from the Lax Property nearshore areas, by Booth Aquatic Research, December 17, 1985.

Station	Water depth (m)	Distance from shore (m)	Composition (%)	Color	Cohesiveness	Texture
1A	0.3	2	100% silt	black	high	greasy&oily
1B	1.0	5	100% silt	black	high	greasy&oily
1C	2.0	10	100% silt	black	high	greasy&oily
1D	2.0	20	100% silt	black	high	greasy&oily
2A	0.5	1	100% silt	black	high	greasy&oily
2B	1.0	5	100% silt	black	high	greasy&oily
2C	1.0	10	100% silt	black	high	greasy&oily
2D	2.0	20	100% silt	black	high	greasy&oily
3A	2.0	5	100% silt	black	moderate	greasy&oily
3B	2.0	10	100% silt	black	moderate	greasy&oily
4A	1.0	1	80% sand 20% silt	grey-brown	low	gritty
4B	2.0	5	50% sand 50% silt	grey	low	greasy
4C	2.0	20	80% silt 20% sand	black-grey	low	greasy
5A	1.0	5	80% sand 20% silt	brown	low	gritty
5B	1.0	10	60% sand 40% silt	grey-brown	low	gritty
5C	1.0	20	60% sand 40% silt	grey	low	gritty
6A	1.0	5	60% sand 40% silt	grey-brown	low	gritty
6B	3.0	10	100% silt	grey	moderate	gritty
6C	4.0	20	100% silt	black-grey	moderate	gritty
7A	1.0	5	60% sand 40% silt	brown	low	gritty
7B	2.0	10	80% silt 20% sand	grey-brown	moderate	-
7C	4.0	20	90% silt 10% sand	black-grey	moderate	-
8A	0.5	3	60% clay 40% silt	grey-brown	high	greasy
8B	1.0	6	90% silt 10% sand	black-grey	moderate	gritty
8C	1.5	10	100% silt	black-grey	high	-
9A	1.0	1	60% sand 20% gravel 15% organic 5% brick	grey-brown	low	gritty
9B	2.0	5	90% silt 10% organic	black	high	gritty
9C	2.0	15	90% silt 10% sand	black	high	gritty

Table 5. Trace metal, PCB, oil and grease and loss on ignition of sediment samples collected from nearshore areas of the Lax Property by Booth Aquatic Research, December 17, 1985. All analysis are in mg/kg unless otherwise noted.

Station	Cadmium	Copper	Chromium	Zinc	Manganese	Nickel	Lead	Loss on ignition(%)	PCB	Oil&Grease
1A	16	82	150	5200	1580	20	945	4.42	0.22	7800
1B	4	122	142	1520	855	130	450	12.50	0.82	14000
2A	3	122	128	560	780	95	180	9.08	0.45	17000
2B	2	340	129	955	1270	400	360	12.43	0.25	6500
3A	10	160	240	2800	1280	180	655	1.34	0.60	11000
4A	2	34	114	360	775	20	56	1.60	<0.01	630
5A	4	30	148	1060	1260	30	260	2.30	0.07	530
6A	2	49	112	380	625	20	76	3.89	0.06	1800
7A	2	50	180	280	630	20	43	2.45	<0.01	230
8A	2	16	190	73	525	20	22	3.21	<0.01	190
9A	3	28	88	370	660	20	71	2.94	<0.01	440

MOE MEANS ‡ 5.7 130 204 2700 1900 44 310 9.8 0.20 -

‡ MOE Hamilton Harbour Sediment Means(MOE,1985)

Table 6. Trace metal concentration(mg/l) of water samples collected from nearshore areas of the Lax Property, December 18, 1985, by Booth Aquatic Research.

Station	Field pH	Cadmium	Copper	Chromium	Zinc	Manganese	Nickel	Lead
1	7.97	0.0	0.02	0.09	0.35	0.08	0.0	0.0
2	8.00	0.0	<0.01	0.08	0.02	0.03	0.0	0.0
3	8.08	0.0	<0.01	0.08	0.00	0.02	0.0	0.0
4	7.95	0.0	<0.01	0.07	0.04	0.03	0.0	0.0
5	7.86	0.0	<0.01	0.06	0.03	0.05	0.0	0.0
6	8.19	0.0	<0.01	0.07	<0.01	0.04	0.0	0.0
7†	8.17	-	-	-	-	-	-	-
8	8.03	0.0	0.00	0.08	0.02	0.07	0.0	0.0
9	8.01	0.0	<0.01	0.07	0.11	0.03	0.0	0.0
10	7.94	0.0	0.03	0.08	<0.01	0.04	0.0	0.0
11	7.93	0.0	0.02	0.06	<0.01	0.04	0.0	0.0
12	7.90	0.0	0.02	0.06	0.08	0.03	0.0	0.0
13	7.95	0.0	<0.01	0.06	0.03	0.04	0.0	0.0

MOE‡‡

Objective 6.5-8.5 0.0002 0.005 0.1 0.03 - 0.025 0.005

< : indicates concentration near the detection limit; real value may be less

† sample not available.

‡‡ MOE water quality objectives for the protection of aquatic life(1984).

Table 7. Description of surface industrial waste deposited on the Property and recommended actions

Site No	Description	Action
1	Foundry sand and brick: one pile on the surface	Leave: unless phenols are very high
2	Foundry rubble similar to (1). Test: leachate for metals and phenols	"
3	Various surface patches of iron oxides mixed with dirt and a few ladle bottoms	Scrape off and remove or cover with clay
4	Slope face 6 m high x 100 m long with mixed iron oxide and dirt. Note: 3-4 m north of slope is Borehole II where a tarry oil is seeping in at 6-7 m. This is being tested for PCBs and may need special handling.	Excavate slope back to clean earth and remove. PCB < 50: stabilize and remove. PCB > 50: remove using special procedures.
5	Iron oxide: one pile near the shore. This This needs to be excavated to the bottom.	Excavate and remove
6	Small isolated pile of iron oxide	Remove
7	Small isolated pile of iron oxide	Remove
8	Isolated pile of aluminum oxide (with copper sulphate)	Remove
9	Battery cases with some old lead plates	Remove
10	Granulated slag	Remove
11	This large expanse is fairly pure iron oxide & with some ladle bottom (5-10). It is fairly	Remove (recycle?)
12	shallow, < 1 m in most sections. It is 7-30 m wide and 200 m long. It does not reach as far as the shore.	
13	Iron oxide: shallow layer on surface	Scrape and remove
14	Iron oxide pile of surface	Remove
15	Slope face and bank of iron oxide. Needs to be excavated back to clean earth	Remove
16	Slope face and small pile of aluminum oxide and copper sulphate in several piles	Remove

Figure 1 .Surface soil samples collected by Ministry
of the Environment, Air Resources Branch, Phytotoxicology
Section, November, 1984.
Taken from Palmer, 1985.

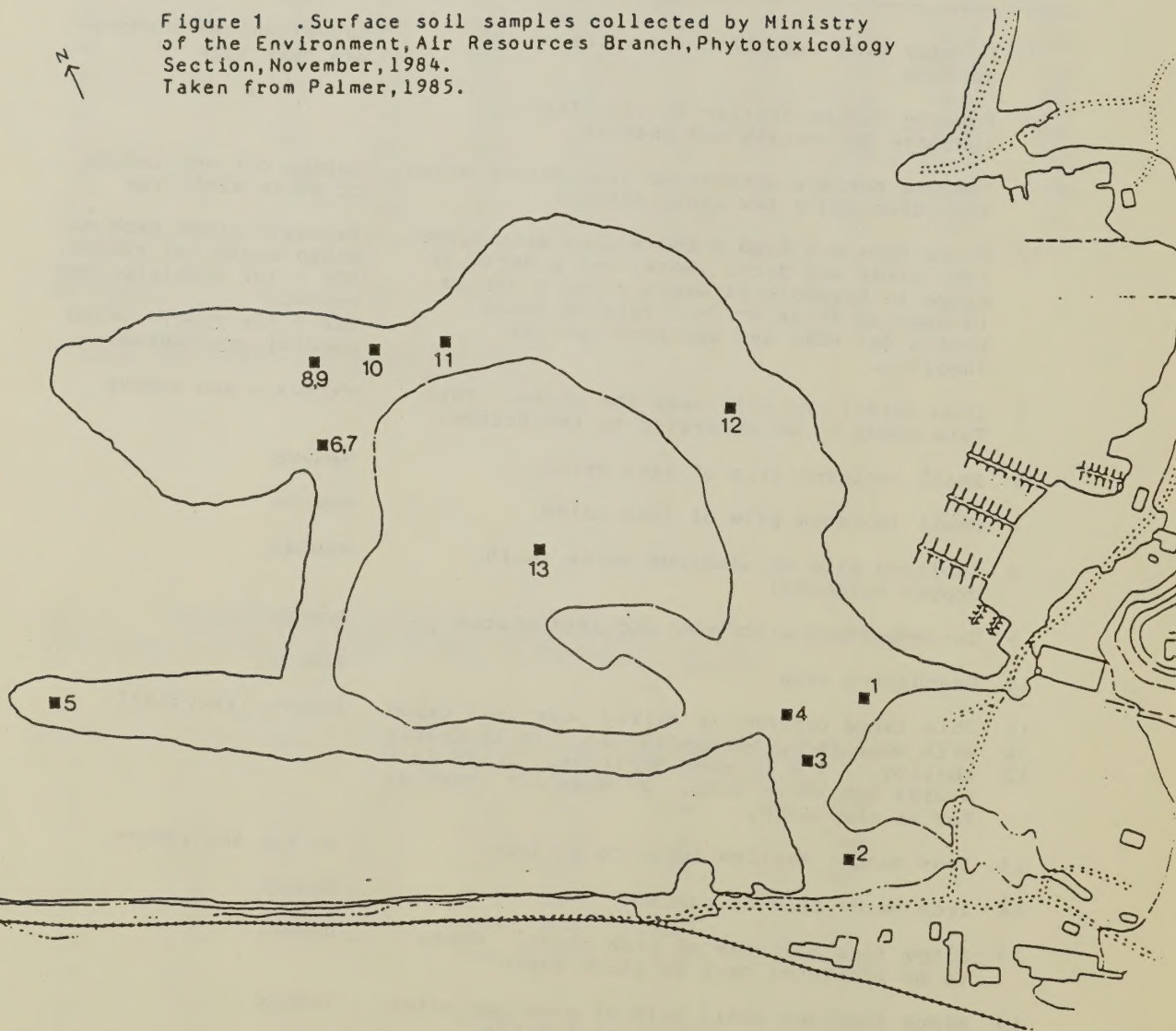


Figure 2 Bore hole locations for samples collected by Hamilton-Wentworth Regional Laboratories, August, 1985. Taken from Forde, 1985.

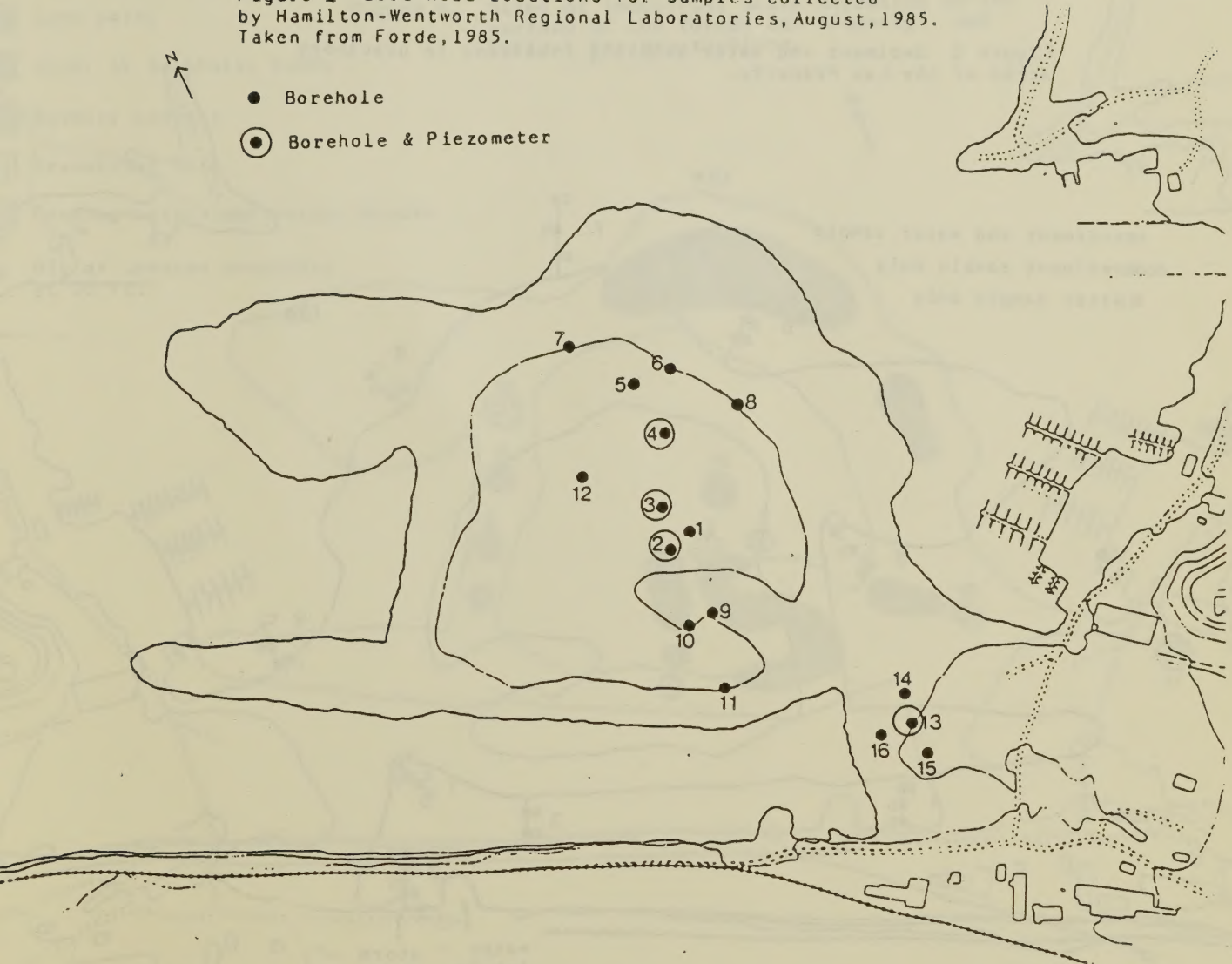
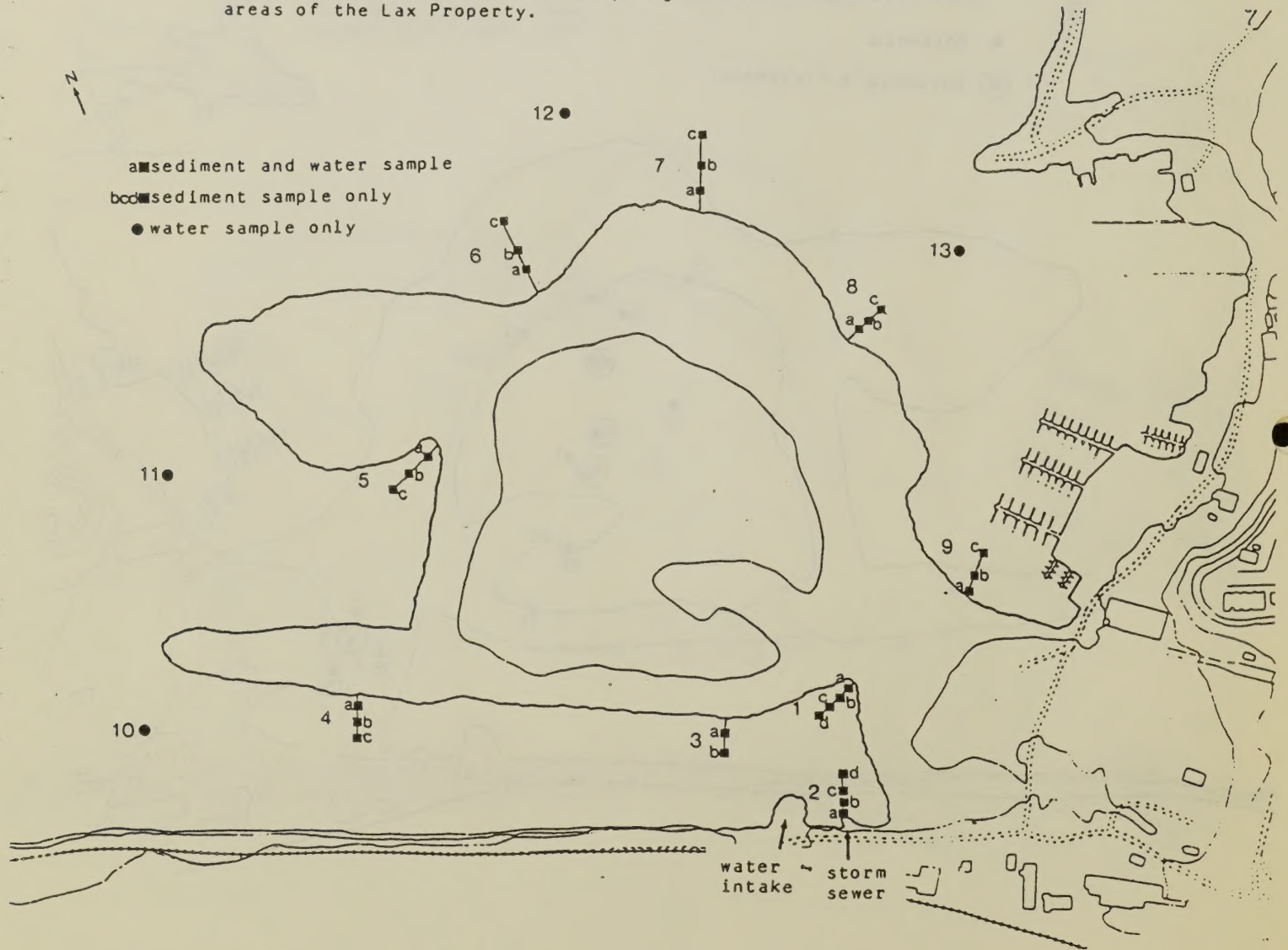
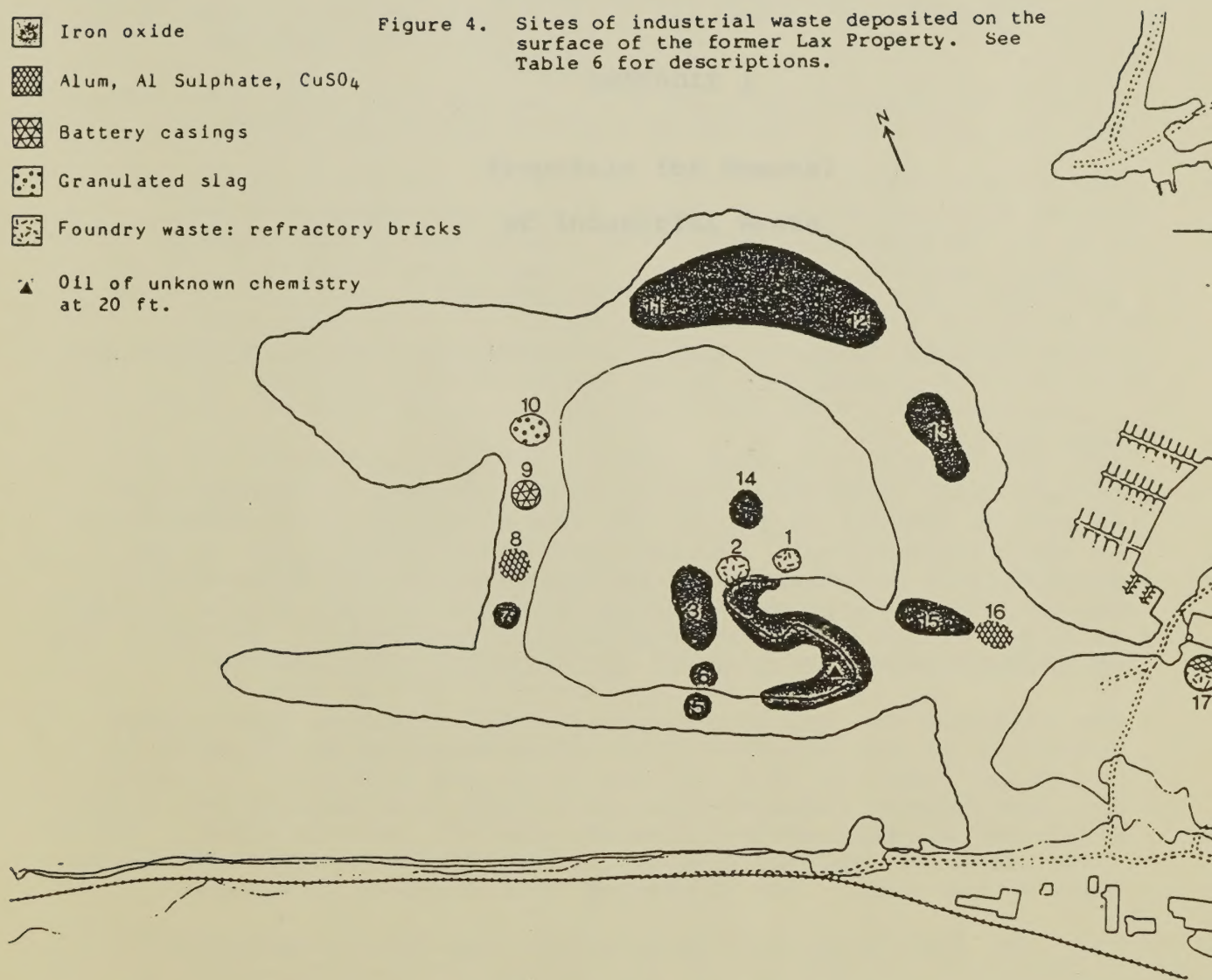


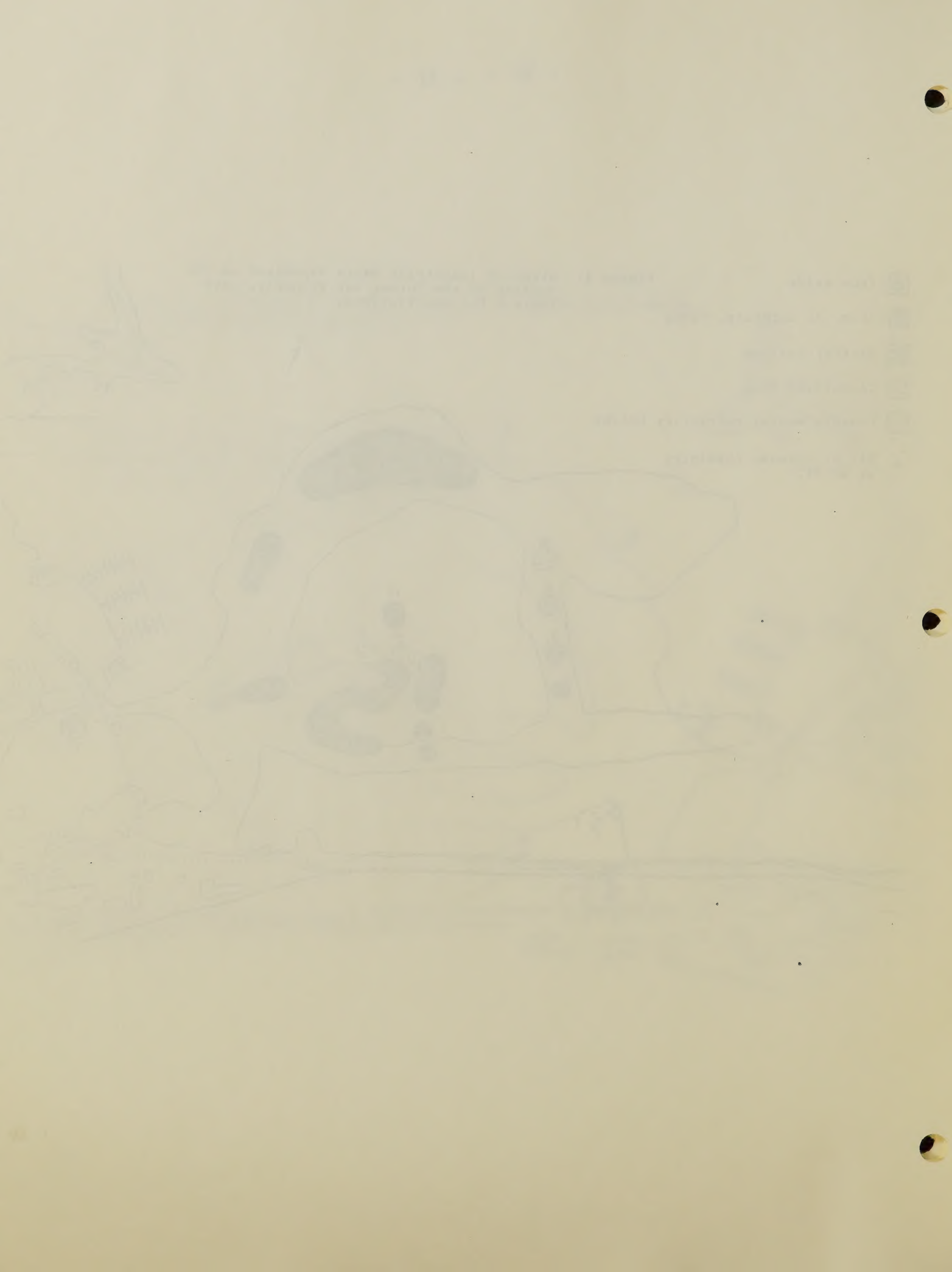
Figure 3 Sediment and water sampling locations in nearshore areas of the Lax Property.



-  Iron oxide
-  Alum, Al Sulphate, CuSO_4
-  Battery casings
-  Granulated slag
-  Foundry waste: refractory bricks
-  Oil of unknown chemistry at 20 ft.

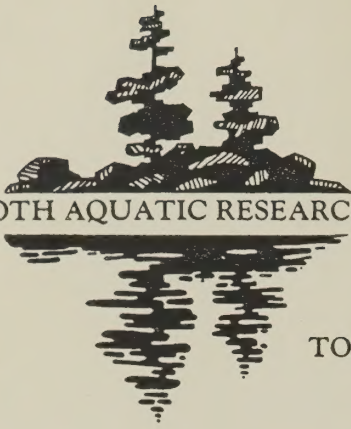
Figure 4. Sites of industrial waste deposited on the surface of the former Lax Property. See Table 6 for descriptions.





APPENDIX 1

Proposals for Removal of Industrial Waste



BOOTH AQUATIC RESEARCH GROUP INCORPORATED

532 QUEEN STREET EAST
TORONTO/CANADA/M5A 1V2

(416) 362-2457

May 29, 1986

Tricil (Sarnia) Ltd.
R.R. #1 (Telfer Side Road)
Corunna, Ontario
NON 1G0

Philip Enterprises Inc.
P.O. Box 423, Station B
Hamilton, Ontario
L8L 7W2

Attention: Mr. Brent Bolger

Attention: Mr. Allen Fracassi

Dear Sirs:

We have been retained by the City of Hamilton to advise them regarding rehabilitation of the former Lax Property (indicated on the attached map). Surface and borehole sampling of the property has revealed isolated instances of hazardous and non-hazardous waste products (as defined by the Ontario Ministry of the Environment - OMOE), primarily iron oxide. We would like to obtain estimates of costs for removing this material.

The attached map and site descriptions* indicate approximate locations of the piles of material identified by the OMOE as requiring removal. The surface areas and locations indicated are approximate. No estimate of tonnage can be made until the extent of contamination below the surface is determined. The final decision to remove material or leave it in place will be made by the OMOE. The following conditions will apply:

- (1) The contractor will provide all excavation equipment.
- (2) The contractor will provide all containers and transportation for material.
- (3) Wheels of transporting vehicles will be washed before leaving the site to prevent tracking of waste into City streets.

* For map and site descriptions, see Figure 4 and Table 7.

- (4) The contractor will arrange with and pay for the City to provide dust control.
- (5) Waste will be excavated to the interface of waste material and clean earth and no further.
- (6) All large iron pieces (such as ladle bottoms) will be removed and recycled where possible.
- (7) If unidentified liquids are uncovered during excavation, the OMOE must be advised immediately and the site must be abandoned until further notice from the OMOE.
- (8) If isolated unidentified drums of liquid are uncovered, they should be set aside until instructions are received from the OMOE. Meanwhile work at that site can continue. If, however, there appear to be many drums, then all work at the site should cease until the OMOE is consulted.
- (9) At Sites 1 and 2, the foundry sand should be tested for phenols. OMOE will then determine whether this material should be removed.
- (10) The oil identified at 6-7 m at borehole II in Site 4 must be tested for PCBs. If the PCB levels are < 50 ppm, the material should be stabilized and removed. If the PCBs are > 50 ppm, then appropriate licences will be required and the OMOE should be consulted.
- (11) Operating hours 07:00 to 17:00.
- (12) Any staging area should be as concealed as possible. A two stage process of first excavation and then handling and transportation is permissible, providing the piles of excavated material are secure.
- (13) The contractor must abide by Regulation 309 of the Environmental Protection Act and by its own licencing requirements. All required manifesting is to be completed by the contractor with appropriate copies being forwarded to the City of Hamilton.

It is appreciated that costs will be partially dependent on volumes. Please advise us in your cost estimate if volume (tonnage) has any effect on your price. A price per ton of material would be appropriate.

If you have questions, please call me or David Ross. A site visit can be arranged. Please note that this request for an estimate does not in any way commit Booth Aquatic Research or the City of Hamilton.

Sincerely,
BOOTH AQUATIC RESEARCH

Gillian M. Booth

c.c. J. Tollefsen, City of Hamilton
J. Vogt, Ontario Ministry of the Environment

Encs.
GMB/rs



PHILIP ENTERPRISES INC.

P.O. BOX 423, STN. B, HAMILTON, ONTARIO L8L 7W2

TEL.: (416) 544-6687

June 10, 1986

Booth Aquatic Research Group Incorporated
532 Queen Street East
Toronto, Ontario
M5A 1V2

Attention: Gillian M. Booth

Dear Mesdames:

Re: Rehabilitation of Former Lax Property

Further to your letter of May 29, 1986 and pursuant to your request, we are pleased to provide you with the following quotation:

For providing all necessary excavation equipment, including mobilization and demobilization;

For providing all necessary containerization and transportation, including stocking of material;

For the wheel-washing of transporting vehicles before leaving site to prevent tracking of waste;

For the provision of dust control;

For the provision of a staging area with appropriate leachate control to free it from contaminated run-off and located to minimize visual impact;

For the processing, transportation and disposal of material, all in accordance with The Ministry of the Environment;

For the provision of appropriate safety wear;

For the provision of full-time supervision and a fully-trained technician with access to our in-house chemist; and

For the provision of a field office to facilitate communication and Ministry of the Environment Liaison;

Our price will be\$110.24 per net ton of contaminated material.

For iron oxide that we are successful in recycling, upon our determination, as opposed to disposal, our price in lieu of the \$110.24 as above, will be\$90.00 per net ton of contaminated material.

For foundry sand, aluminum oxide, battery cases, granulated slag, and copper sulphate that upon Ministry direction can go directly to site specific landfill, without processing, our price will be\$25.00 per net ton of contaminated material.

Should screening be necessary for any material in order to facilitate processing, our price will be\$3.50 per net ton of contaminated material screened.

Should grading of any area be required, our price will be\$1.50 per yard of material used for regrading, as determined by the City Engineer.

A price for the stabilization and removal of PCB contaminated material of less than 50 ppm can only be given when the actual extent of contamination is determined. However, our price of\$110.24 may be used as a guideline.

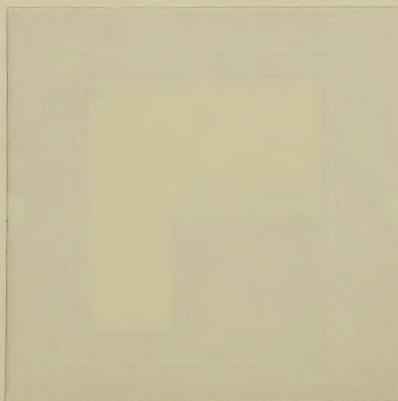
A minimum four hour standby charge of \$100.00 per hour will apply for downtime caused by factors beyond our reasonable control.

All testing required by the Ministry will be extra.

Please be advised that this is a joint proposal by Philip Enterprises Inc. and Solid Waste Reclamation Inc., a wholly owned subsidiary of The Waxman Holding Corporation Inc. All invoicing will be done by Solid Waste Reclamation Inc.

The following conditions will apply:

- (1) Our batch plant weigh scale will govern weights of all processed materials. A scale, agreeable to both parties, will govern weights of all other materials not requiring processing.
- (2) Invoices, for work completed, will be rendered every two weeks for net payment within 30 days, with a 2% per month charge on overdue accounts.
- (3) Waste will be excavated to the interface of waste material and clean earth and no further, as determined by The Ministry of the Environment. The final decision, to remove material or to leave it in place, will be made by The Ministry of the Environment.
- (4) All large iron pieces (such as ladle bottoms) will be removed and recycled where possible.
- (5) If unidentified liquids are uncovered during excavation, The Ministry of the Environment will be advised immediately and the "specific site" will be abandoned until further notice from The Ministry of the Environment.
- (6) If isolated, unidentified drums are uncovered, they will be set aside until instructions are received from The Ministry of the Environment. Meanwhile, work at that site will continue. If, however, there appear to be many drums, then all work at the "specific site" will cease until The Ministry of the Environment is consulted.
- (7) Operating hours 07:00 to 17:00.
- (8) Regulation 309 of the Environmental Protection Act will be abided by, as well as our own licensing requirements. We will complete all required manifesting with appropriate copies being forwarded to the City of Hamilton.

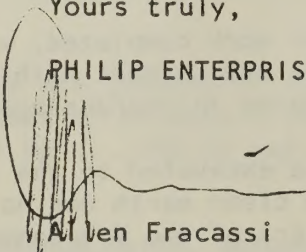


Thank you for affording us this opportunity to present our quotation. Rest assured of our continued attention to the City's interests and to the strict requirements of our industry.

We hope this meets with your favour.

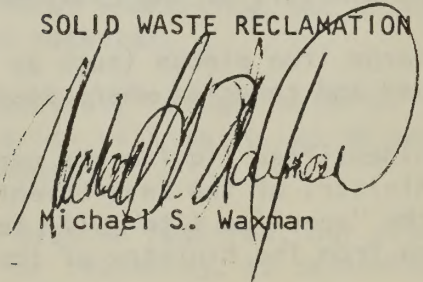
Yours truly,

PHILIP ENTERPRISES INC.



Allen Fracassi

SOLID WASTE RECLAMATION INC.



Michael S. Waxman



June 12, 1968

Ms. Gillian Booth
Booth Aquatic Research Group Inc.
532 Queen St E.
Toronto, Ont.
M5A 1V2

Dear Ms. Booth:

Thank you for this opportunity to quote on the Lax Property excavation and disposal requirements. Tricil's suggested site procedure and quotation are attached.

It is our proposal to remove the leachate toxic heavy metal wastes for entombment into Tricil's secure chemical Landfill situated in the Sarnia vicinity. This site is located on Tricil owned land which has an extremely low permeability lacustrine clay. A geologic formation such as this ensures that water mobility is drastically impeded and hence the restriction of heavy metal migration. The resulting advantage of such a site is the reduced liability for future environmental impairment and the associated financial responsibilities.

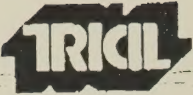
On behalf of Tricil, I thank you in advance for presenting our proposal to the City of Hamilton. I look forward to working with Booth Aquatic Research and the City of Hamilton in providing the necessary equipment and experience in managing the environmental restoration of the Lax Property.

If you should have further inquiries, please feel free to contact me personally.

Yours truly,
Tricil (Sarnia) Limited

A handwritten signature in cursive script that reads "Brent Bolger / B.".

Brent Bolger, B.Sc.
Technical Sales Representative



LAX SITE PROPOSAL - HAMILTON

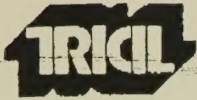
Stage 1 - Pework and On-site Preparation

1. Review PCB analysis results from M.O.E. Hamilton. Immediate review of future direction to be reassessed if PCB's identified.
2. Extract samples of foundry sand and rubble at sites 1 and 2 and forward to Xenon Labs for analysis of phenols. Based on sample results this material may be removed or left as is on-site. Acceptable limits of phenols will be determined by the M.O.E.
3. Determination of collection/staging area to be arranged through discussion with Booth Aquatic Research, City of Hamilton, Tricil, and Tricil's subcontractor.
4. Excavate dyke staging area, truck decontamination area, and drum holding area on-site.
5. Co-ordinate with the City of Hamilton a street cleaning schedule to accommodate terms of tender request.
6. Identify through consultation with Booth Aquatic Research, and the City of Hamilton authorized personnel to sign manifests.
7. Confirmation of purchase order and any restrictions (volumes or dollars) be reviewed.
8. Through consultation with the City of Hamilton, Booth Aquatic Research, Tricil, and Tricil's subcontractor, the final disposition (i.e. backfill, grading, etc.) will be reviewed.
9. Booth Aquatic Research or designate will be required to stake out areas of excavation to ensure the appropriate areas of contamination will be excavated and removed. M.O.E. approval of excavation required at each site identified before backfilling or grading.

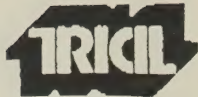
Stage 2 - Commencement of Site Excavation

1. There are two major sites of excavation - site 4 and site 11, 12. In conjunction with site 4- sites 1, 2, 3 and 14 may also be directly loaded into vehicles. If deemed necessary by Tricil and Tricil's subcontractor this material, in part or in whole, may be removed to the staging area.
2. Secondary sites of contamination include sites 5-6, 13, 15 and 16. These materials may be loaded directly at contamination sites or moved to the staging area as deemed necessary by Tricil, and Tricil's subcontractor.

cont'd....2.



3. Tertiary sites of contamination includes 10, 9 8, 7 and possibly 17 (no stipulated requirements previously identified by Booth Aquatic Research). These sites will be excavated and moved to staging area.
 4. Shipments to Tricil Sarnia will commence in conjunction with available volumes for shipment (6 truckloads/day). Trucks will be washed in dyke area before leaving site.
 5. Work will continue from 0700 to 1700 hours each day until completed.
 6. Excavated drums or unknown materials will be left in the site area until identification is possible or relocation to containment site if safe transfer deemed possible. Any further action on these materials will be done in conjunction with normal Tricil procedures and M.O.E. discussions. Costs incurred will be negotiated should this occurrence arise.
- If PCB's are identified during excavation, Tricil reserves the right to withdraw from the project immediately. Any costs incurred to this point will be assessed for payment.
7. Liquid truck washings will be coded and removed as a liquid for disposal if necessary.
 8. Grading and/or backfilling will be the final sight closure measure.
 9. On-going approvals (consultation will be requested from the M.O.E., City of Hamilton, and Booth Aquatic Research. In this way any deviations from the anticipated project can be discussed and assessed at the time of the occurrence.
 10. Excavated ladle bottoms to be set aside for reclaim by the City of Hamilton directly.



LAX PROPERTY QUOTATION
CITY OF HAMILTON

Site Preparation and Set-up

A) Preparation

- includes equipment delivery and removal from site and sample analyses set-up charges

\$3,000.00 per mobilization
(one anticipated)

B) Excavation

- rates are based on 8 hour days for one bull dozer, one backhoe, one tandem dump truck, truck rinsing equipment, layover and site supervision. Estimates for excavation of waste are at approximately 125 - 150 tons per day.

Excavation Charges -	\$2500.00/day.
Overtime if required @ an additional	\$ 120.00/hr.

C) Transportation and Disposal

- Transportation to Tricil Sarnia for entombment into secure landfill @

\$60.00/ton Imp.

D) Extra Items

- 1. Street cleaning costs will be assessed by the City of Hamilton and these charges will be invoiced back to the City at cost.
- 2. Unspecified or unusual extra items will be invoiced at Tricil rates or cost plus 20%, whichever is applicable. Tricil will endeavour to make these costs known in advance if possible.

E) Steel Reclaim - Ladle Bottoms

- Uncovered ladle bottoms will be set aside for steel reclaim by the City of Hamilton for direct negotiation.

COMPARISON AND RECOMMENDATIONS

Comparison

The following is an attempt to compare the two proposals.

- (1) Methodology is substantially different between the proposals, making costs difficult to compare. Exact costs cannot be developed as the underground extent of material requiring removal cannot be determined until excavation proceeds. Estimates based on approximate surface area of the industrial waste range from 500 to 2,000 tons of material to be removed, with a best guess of 1,000 tons. Based on the proposals and several assumptions outlined below, the following table presents costs for three tonnage estimates. Note that while the Philip Enterprises proposal allows a cost saving if material is found to be recyclable, Tricil will not attempt recycling. This could result in cost savings based on recycled material and is reflected in the table below.

Total Cost Estimate for Removal and Disposal of Waste
(rounded to the nearest \$100)

	TOTAL TONS TO BE REMOVED		
	500	1,000	2,000
Tricil Ltd.	\$ 44,100	\$ 84,300	\$ 164,000
Philip Enterprises Inc.:			
(a) No recycling	\$ 47,700	\$ 103,500	\$ 215,300
(b) 50% recycling	\$ 42,600	\$ 93,400	\$ 176,800

- (2) Philip Enterprises Ltd. is able to commence the operation immediately on award of a contract. Tricil Ltd. is not in a position to begin until mid-August. The environmental impact of a one or two month delay is negligible. We are not in a position to comment on the social impact or public perception of the problem. The time delay caused by awarding the work to Tricil must be weighed against the extra cost incurred by going to Philip.

Assumptions:

- (1) 100 tons of material such as foundry sands and battery casings could potentially be removed by Philip at \$25/ton. Tricil would still charge \$60/ton plus associated costs of excavation.
- (2) City street cleaning was not included explicitly by Tricil and an arbitrary \$1,000 has been added to their cost. Similarly, weighing of trucks has not been included explicitly and an arbitrary \$.25/ton has been added to their cost.
- (3) Tricil has estimated 125 to 150 tons per day for excavation and incidental costs for a total cost of \$2,500 per day. Assuming the lower tonnage per day, a cost of \$20 per ton has been estimated. This estimate explicitly includes regrading and filling.
- (4) Regrading by Philip would cost \$1.50/cu.yd. A density of 1.4 tons/cu.yd. has been used to arrive at a cost of \$2.10/ton. Each ton of material removed is assumed to be replaced by a ton of fill.
- (5) No mention is made in the Tricil Ltd. proposal of costs recouped from recycled ladle bottoms and iron scrap from abandoned machinery. These benefits would accrue to the City under Tricil management and would accrue to Philip Enterprises under their management.

Recommendations

- (1) Based on cost, it would be advantageous to contract Tricil Ltd. to conduct the removal operation.
- (2) If a delay of 2 months is unacceptable, then the work should be awarded to Philip Enterprises Inc.

APPENDIX 2

Monitoring Program Design for the Former Lax Property

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Monitoring Program Design for the Former Lax Property

Purpose: To detect any serious deterioration in either the groundwater quality of the Property or in the nearshore environment which could be attributed to contamination from industrial waste deposited in the Property.

Methods:

- (1) Future groundwater deterioration is one concern. Annual early summer monitoring will allow some comparison of water chemistry between years. It also leaves enough time during the ice-free season to do further testing or to implement mitigative measures if groundwater contamination becomes a problem. Until the site is further developed, the existing piezometers should be sampled once in early summer each year and analysed for the parameters in Table 1.
- (2) If development proceeds, new piezometers should be installed at 4 locations, near the current piezometer sites, consistent with the design of the development. These should be monitored as above. These need not be set in industrial waste interfaces but should be representative of groundwater in the Property.
- (3) At some point prior to any development, an underwater inspection should be made of the perimeter of the Property. This should determine whether there are any exposed sites of industrial waste which could be excavated during the dredging phase of construction. It should also determine whether any oil or tar, such as was found at Borehole 11, is seeping out of the site. This underwater survey could be repeated at two year intervals as part of the early summer monitoring program. Any future seepage would be then detected early enough to deal with the problem before any unsightly, potentially hazardous material becomes a major issue for the City.
- (4) If development proceeds, there will almost certainly be an annual water quality monitoring program required, at least for the near future. Part of that program should include monitoring nearshore water quality to detect any major deterioration in water quality. This program would allow a determination of the amount of contamination entering the Harbour from the Property. If development does not proceed, then conditions should not change substantially from the December, 1985 monitoring. A repetition of that study could be conducted at five year intervals to ensure no major

changes have occurred. Any significant deterioration in the groundwater quality should, however, be detected by the piezometer monitoring before it reaches the nearshore environment.

- (5) The Ministry of the Environment have suggested a study of the flux of groundwater reaching the nearshore water. Major anions and cations (Na, K, Mg, Ca, Cl, SO₄) should be monitored over one year, beginning once the excavation of industrial waste and regrading is complete. Comparison of levels of conservative elements will allow better estimates to be made of the impact of the groundwater from the Property on the nearshore environment.

The Ministry of the Environment and the Canada Centre for Inland Waters are currently designing part of a Remedial Action Plan (RAP) for Hamilton Harbour. As this project is an integral part of the Harbour, it may be possible to include monitoring of nearshore water quality as part of the RAP.

Table 1. Parameters to be analysed during annual groundwater monitoring

Metal contaminants:	A standard ICAP scan for 26 elements on filtered water samples will include the metals of concern, i.e., Hg, Zn, Cd, Cu, Pb, Cr.
Organic contaminants:	A test for total organic halides (TOX) and dissolved organic carbon (DOC) will demonstrate any significant increase of most of the common organic contaminants. If a substantial increase in TOX or DOC were found, further testing would then be required.
Standard parameters:	pH and conductivity should be tested routinely. Major changes in either parameter should be investigated further.

Mitigative Measures:

In the event that future evidence points to contaminants leaching from the Property into the Harbour, to the surface of the Property or into the proposed artificial lake, remedial action would be required. Potential remedies will depend on the source and the nature of the contamination and will not be discussed at length here.

The remedies may include excavation of sources of contamination,

sealing of areas with impermeable boundaries and/or altering surface drainage patterns to deflect percolation of precipitation through the site.

GLOSSARY

- Alloy:** Mixture of metals
- Contaminant:** Any solid, liquid, gas, odour, heat, sound, vibration, radiation or combination of any of them, resulting directly or indirectly from the activities of man which may impair the quality of the natural environment for any use that can be made of it, cause injury or damage to property or to plant or animal life, cause harm or material discomfort to any person, adversely affect the health or impair the safety of any person, or render any property or plant or animal life unfit for use by man.
- Contaminated waste:** Useless remains of a process which contain contaminants
- Hazardous waste:** Useless remains of a process which are a threat to man in the environment. MOE chemical criteria will classify waste as hazardous or non-hazardous.
- Industrial waste:** Any useless remains of industrial processes.
- Leachate:** The collected liquid after percolation through some material.
- Leaching:** The percolation of a liquid through some material.
- Lethal:** Stimulus or effect sufficient to cause death directly.
- mg/kg:** Milligrams per kilogram - units of measure expressing the concentration of a substance in a solid, equivalent to one part per million (ppm).
- mg/L:** Milligrams per litre - units of measure expressing the concentration of a substance in a solution, equivalent to one part per million (ppm).
- Non-hazardous waste:** Useless remains of a process which are not a threat to many in the environment.
- Oxidized:** Has been combined with oxygen.
- Phytotoxicity:** Effect of a poisonous substance on plants.
- . .

GLOSSARY OF TERMS

Piezometer: An instrument for measuring groundwater pressure or collecting groundwater.

Sublethal: Stimulus or effect insufficient to cause death directly.

Toxicity: Effect of a poisonous substance.

Waste: Useless remains of a process.







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